Claims

1. A metallic liquid jet cutting system for modifying a workpiece comprising:
a dispenser for dispensing a jet stream of an electrically conductive fluid; and
a power source electrically coupled to the jet stream.

2. The system of claim 1 wherein the dispenser comprises a jetting head.

3. The system of claim 2 wherein the jetting head comprises a crucible

4. The system of claim 3 wherein the crucible comprises a top, a sidewall, and a bottom, wherein the top comprises an inlet and the bottom comprises an outlet.

5. The system of claim 3 wherein the crucible comprises one of boron nitride-zirconia-silicon carbide, Yttria-Stabilized-Zirconia, Magnesia-Stabilized-Zirconia, Calcia-Stabilized-Zirconia boron nitride, Cubic Zirconia, alumina, silica, silica composites and zirconium diboride.

6. The system of claim 3 further comprising a heater coupled to the crucible

7. The system of claim 6 further comprising a second power supply electrically coupled to the heater.

8. The system of claim 2 wherein the jetting head comprises an inlet for receiving a feed stock of the conductive material.

9. The system of claim 1 wherein the conductive material comprises mild steel, aluminum, aluminum alloy, tin, stainless steel, iron, cast iron, tool steel, copper, zinc, gold, silver, or platinum.

10. The system of claim 2 wherein the jetting head comprises a pressure containment vessel.

11. The system of claim 2 wherein the jetting head comprises an electrode disposed inside the crucible for establishing an electrical connection with the jet stream.

12. The system of claim 11 wherein said electrical connection comprises a feedstock of

conductive material.

13. The system of claim 2 wherein the jetting head comprises an exit orifice.

14. The system of claim 2 wherein the jetting head further comprises a nozzle.

15. The system of claim 14 wherein the nozzle comprises a disk having a through orifice.

16. The system of claim 15 wherein the disk comprises a material selected from one of Yttria-Stablized-Zirconia, Magnesia-Stabilized-Zirconia, Calcia-Stabilized-Zirconia, boron nitride-zirconia-silicon carbide, boron nitride, Cubic Zirconia, Alumina, Silica, Silica Composites, Zirconium Diboride.

17. The system of claim 15 wherein the through orifice comprises a circular cross section.

18. The system of claim 6 wherein the heater comprises one of an AC resistance heater, a DC resistance heater, an induction heater, or a combustion burner-heater arrangement.

19. The system of claim 3 wherein the crucible comprises a refractory material.

20. The system of claim 3 wherein the crucible comprises ceramic material.

21. The system of claim 3 wherein the crucible comprises a material selected from one of alumina, zirconia, boron nitride, and graphite.

22. A metallic liquid jet cutting system comprising:

a jetting head including an inlet for receiving a feed stock of a conductive material and an exit orifice for dispensing a jet stream of a conductive fluid;

a heater coupled to the jetting head; and

a power source electrically coupled to the jet stream for providing a current to the jet stream to increase a temperature of the jet stream.

23. A process for modifying a workpiece comprising:

(a) providing a jet stream comprising a conductive fluid;

(b) coupling an electrical current into the jet stream; and

(c) directing the jet stream to the workpiece for modifying the workpiece.

24. The process of claim 23 wherein step (b) comprises heating the jet stream by passing the electrical current through the jet stream.

25. The process of claim 23 wherein step (a) comprises (a1) providing a feed stock of the conductive fluid, (a2) heating the feed stock to form the conductive fluid; and (a3) passing the conductive fluid through an exit orifice, thereby forming the jet stream.

26. The process of claim 23 wherein step (a) comprises providing one of a continuous jet stream, a pulsed jet stream, a steady jet stream, or a unsteady jet stream.

27. The process of claim 23 wherein the feed stock comprises a wire, bar, or powder.

28. The process of claim 23 further comprising the step of (d) lowering a melting point of the workpiece.

29. The process of claim 28 wherein step (d) comprises lowering the melting point by forming an alloy of the feed stock.

30. The process of claim 25 wherein the feed stock comprises one of iron, aluminum, tin, nickel, titanium, gold, platinum, silver, magnesium, and copper.

31. The process of claim 23 wherein the conductive fluid comprises a low melting point of less than 1000° K and a high boiling point higher than 2500 ° K.

32. The process of claim 25 wherein the feed stock comprises a plurality of non-melting particles.

33. The process of claim 32 wherein the non-melting particles are abrasive.

34. The process of claim 23 wherein step (c) comprises one of cutting, marking, piercing or

welding the workpiece.

35. The process of claim 23 wherein step (b) comprises applying a current to the jet stream through an electrode coupled to the conductive fluid and a current collector disposed near the workpiece.

36. The process of claim 23 wherein step (a) further comprises providing a levitation force to the conductive fluid to plug the exit orifice.

37. The process of claim 25 wherein step (a1) comprises providing the feed stock in a jetting head.

38. The process of claim 25 wherein step (a3) comprises passing the conductive fluid through a nozzle.

39. The process of claim 23 further comprising providing a shielding gas to the jet stream

40. The process of claim 25 wherein step (a3) comprises pressurizing the jetting head while passing the conductive fluid through the exit orifice.

41. The process of claim 25 wherein step (a3) comprises pressuring the jetting head by supplying an inert gas.

42. The process of claim 23 wherein step (b) comprises heating the jet stream through ohmic power dissipation.

43. The process of claim 23 wherein step (b) comprises heating the jet stream to a temperature substantially above a melting temperature of the conductive fluid.

44. The process of claim 23 wherein step (c) comprises controlling a depth of penetration of the jet stream on the workpiece.

45. The process of claim 23 wherein step (c) comprises adjusting a velocity of the jet stream.

46. The process of claim 25 wherein step (a3) comprises controlling a pressure in the jetting

head.

47. The process of claim 25 wherein step (a2) further comprises controlling a temperature of the conductive fluid.

48. The process of claim 23 further comprising moving the workpiece relative to the jet stream.

49. The process of claim 23 further comprising providing a current collector comprising a conductive material disposed underneath the workpiece, the current collector forming an electrical contact with the jet stream.

50. The process of claim 25 wherein the feed stock and the workpiece comprise a same material.

51. The process of claim 25 wherein the feed stock and the workpiece comprise different materials.

52. A crucible for a metallic liquid jet cutting system, wherein the crucible comprises side walls and a base, the crucible being formed of a zirconium containing compound that is electrically conductive and is resistant to dissolving in the presence of a metallic melt.

53. The crucible of claim 52 wherein the metallic melt comprises one of iron, iron containing compound, and aluminum.

54. The crucible of claim 52 wherein the crucible comprises one of zirconia diboride and yitria-stabilized-zirconia.

55. A nozzle for a metallic liquid jet cutting system, wherein the nozzle comprises a disk-structure having an orifice, wherein the orifice is located at a center of the disk-structure, the nozzle being formed of a zirconium containing compound that is electrically conductive and is resistant to dissolving in the presence of a metallic melt.

56. The nozzle of claim 55 wherein the metallic melt comprises one of iron, an iron containing compound, and aluminum.

57. The nozzle of claim 55 wherein the nozzle comprises zirconium diboride.

58. The process of claim 25 wherein the feedstock is one of tin, aluminum, iron, and mild steel.

59. The system of claim 8 wherein the jetting head comprises at least two inlets for receiving multiple feedstocks of the conductive material.

60. The system of claim 59 wherein a third power source is connected to at least one feedstock.

61. The system of claim 6 wherein the heater is an induction heater having a characteristic frequency that can be calibrated to the level of the conductive fluid.

62. The process of claim 23 wherein step a) further comprises filtering the conductive fluid.

63. The system of claim 3 wherein the crucible further comprises a conductive fluid filter.